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EFFECTIVE STRATEGIES FOR TEACHING MATH TO STUDENTS WITH DISABILITIES

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ABSTRACT

Modern education requires that teachers educate ALL students using research-based strategies in inclusive classrooms. The following review offers a research-based guidance that explores on the different educational methods and curriculum that are designed to assist students with significant learning difficulties in learning mathematics, including students with disabilities. The paper provides technical assistance for teachers and instructors dealing with students with disabilities reflecting "best strategies" for implementing interventions to enhance educational practices in the process of teaching math. Some of the strategies for teaching students with disabilities that are reviewed in this paper include explicit and direct generative strategy training, reduction of math anxiety, adoption of general instructions, use of appropriate mathematical communication, multistep problem-solving strategy, schema instruction, and cognitive strategy instruction. In addition, peer-assisted learning is reviewed as a strategy that can be used to improve teaching among students with disabilities. This paper will review the various scholarly evidences on strategies that can be used to teach students with disabilities, with a view of identifying the most effective strategies in teaching math and how best they can be utilized.

KEYWORDS: Strategies, Disabilities, Peer-assisted learning, and Instructions.

Introduction

Educators often come across challenges when delivering effective instruction to students with significant learning difficulties. With the advent of inclusion in the education system, it is important for teachers and instructors to understand the most efficient strategies that can be used to teach students with disabilities. Mathematics is perceived as a difficult subject in many quarters thus, mathematics teachers should understand strategies that promote better understanding and good performance. The adoption of inappropriate strategies for students with disabilities by Mathematics teachers may result to poor performance and discouragement among these students. In this paper, through a review of past literature, we will establish the best strategies that mathematics teachers can apply for students with learning disabilities.

Research Problem

Generally, math is regarded as a difficult subject and this implies that learners with disabilities may experience more difficulties in the course on learning the subject. Particularly, students with disabilities who learn in general instructional setting may face difficulties if the strategies in use fail to meet their needs or they do not appeal their preferences. Therefore, there is a need for awareness among math instructors on the most effective strategies for teaching math to students with disabilities. Nonetheless, this may not always be the case because most scholars in this field select specific strategies to focus on. The study aims at presenting a synthesis of the different research findings from various researchers which offer the best math teaching strategies for students in the study's target population. It will help teachers to meet the needs and preferences of students with disabilities as well as ensuring that they are not left behind in their coursework.

Research Questions

This main research question in this study is;

1. What are the best strategies for teaching math to students with disabilities?

Specific Questions

2. What are the most effective strategies for teaching math to students with learning disabilities?

3. How do peer-assisted learning strategies compare with other strategies used to teach math to students with disabilities?

Best Strategies for Students with Disabilities

Students may have varying disabilities that necessitate alterations and application of instructional strategies to facilitate learning. Swanson, Moran, Luisser& Fung (2014) state that "explicit and direct generative strategy training" can be used to facilitate learning among students with math disabilities (p. 111). The study was conducted to investigate the effectiveness of explicit and direct generative strategy training and they found out that this form of training had a significant impact in improving the accuracy in word problem solving. The effectiveness of this training strategy consists of various components such as explicitly directing learners to pay attention to the propositions made in word problems. The explicit direction of students' attention enabled them to paraphrase the propositions made by different questions and restate them in ways that supported their comprehension and problem solving (Swanson, et al., 2014). However, the findings from this study also revealed that the effectiveness of this strategy relied on the level of working memory capacity (WMC). As a result, students with difficulties in solving math problems and have a higher WMC have a higher likelihood of benefiting from similar interventions (Swanson, et al., 2014).

Similarly, Wadlington and Wadlington (2008) conducted a study to determine the strategies that can promote the success of math students with disabilities. The study initially identified the causes of math difficulties including language difficulties, low levels of motivation, math anxiety teacher inexperience. The researchers also established the significance of learning styles and explained that some students had either quantitative or qualitative learning personalities or styles (Wadlington & Wadlington, 2008). Those with quantitative learning personalities and styles "are usually good with language skills and concepts", while those with qualitative learning styles usually "focus on the visual-spatial, holistic, and inductive aspects" (Wadlington & Wadlington, 2008, p. 4). This is vital information that can be used to determine the strategies that are selected for learners, and the usefulness of those strategies.

According to Wadlington and Wadlington (2008), math anxiety should be treated to alleviate difficulties in mathematics. This enables students with learning difficulties to focus on problem solving without experiencing the disorientation that comes from math anxiety. Consequently, overcoming the problem of math anxiety assists students in attaining academic excellence in math. Nevertheless, there some cases where math anxiety can be overcome through the achievement of success (Wadlington & Wadlington, 2008). In such cases, students achieve success first and this motivates them to overcome the anxiety that is associated with math subject. Evidently, anxiety can be alleviated before success or after success. Wadlington & Wadlington (2008) argued that teachers can use various techniques to minimize anxiety in students including ensuring that students do not feel threatened in the course of learning and evaluation as well as assisting each student to achieve success. Teachers should commend students for work well done, encourage and recognize progress and offer motivation by reflecting on how they or other successful individuals overcame anxiety. In addition, it is suggested that teachers can incorporate games to enhance anxiety reduction.

Aside from reducing anxiety, instructors should also adopt general instructions that enhance learning among learners with math difficulties. Students with learning difficulties should seat near their instructors to ensure that they can focus on provided instructions. Moreover, these students should be actively involved in the learning process and they should be given a chance to construct knowledge. This echoes suggestions by Swanson, et al., (2014), as the strategies clearly facilitate engagement and knowledge construction. Wadlington & Wadlington (2008) emphasized that teachers should break down concepts and skill into the smallest possible portions, for students with math difficulties. Instructors should also give students optimal work and offer swift feedback for small tasks. In addition, teachers should ensure that the adopted materials are suitable, multisensory instruction is utilized, more time is provided for particular tasks and practical skills are highlighted for students with disabilities (Wadlington & Wadlington, 2008).

In their study, Wadlington and Wadlington (2008) also supported the adoption of appropriate mathematical communication. They explained that teachers should model vocabulary and expound it to students with disabilities. Proper communi-

cation between instructors and students ensure that students comprehend mathematical problems and they adopt suitable strategies to solve them. Wadlington&Wadlington (2008) also made reference to word problems and suggested that they should be linked to learners' experiences. Furthermore, the appropriate formal and informal assessment strategies should be utilized (Wadlington&Wadlington, 2008).

Students may also face emotional and behavioral problems that necessitate the adoption of different strategies. Alter (2012) conducted research whose purpose was to establish the effectiveness of the "multistep problem-solving strategy", in enabling students with emotional and behavioral problems to improve their behavior and problem solving abilities during learning sessions (p. 55). The study found out that the multistep problem-solving strategy successfully enhanced the students' abilities to solve word problems. The findings also indicated that on-task behavior was enhanced by using multistep problem solving strategy. In addition, the results also showed that self-monitoring reduced the emotional and behavioral problems of students and this improved the students' abilities to solve problems (Alter, 2012). The study by Alter (2012) is differs from those by Swanson, et al (2014) and Wadlington and Wadlington (2008), as the former scholar focuses on emotional and behavioral problems. However, all the three studies offer meaningful suggestions that would improve math learning among student with disabilities.

Effective Strategies for Students with Learning Disabilities

Studies have shown that there are a number of effective strategies for teaching math to students with learning disabilities. For example, a study by Krawec et al (2012) sought to identify the effectiveness of Solve It! on students' abilities to comprehend problem solving strategies. The use of Solve It! enabled students to take part in verbal rehearsal as well as practically thinking aloud as modeled by their instructors (Krawec, et al., 2012). These study results indicated that Solve It! gave students the opportunity to enhance their comprehension of different problem solving strategies that improve problem-solving proficiency, and enhance solution accuracy. Notably, the successfulness of the Solve It! approach also depended on students' understanding of the various problem solving strategies for math problems. Teachers adopt Solve It! to promote remembrance of those strategies and their implementation as learners solve problems in math. According to Krawec et al (2012), teachers seeking to adopt Solve It! should establish; the individual strategies used by students to comprehend word math problems, the frequency of reading questions, the steps they take to ensure they understand problems, the questions they ask themselves before solving word problems, the way they re-word word problems, the mental images of the word problem they generate, the plans they make to solve word problems, the identification of operations needed to solve problems, estimation, and checking. Therefore, instructors need to ask questions that lead to the establishment of these strategies, all of which help the student with learning disabilities to solve word problems more effectively.

Another study by Kiuhara and Witzel (2014) identified some of the strategies that can assist students with learning difficulties to solve mathematics problems. There are various pedagogical strategies outlined in this study including systematic and explicit instruction, visual representation of mathematical ideas, promoting progress and monitoring, supporting motivation, organization and self-reflection, establishment of sequential patterns and promoting of peer instruction. Some of the strategies that were suggested for use with students with math difficulties include explicit instruction which according to Swanson, et al (2014), enhanced motivation, progress facilitation and monitoring. Self-monitoring is also suggested by Maccini, Mulcahy& Wilson (2007) who established that it is a strategy which allows learners to determine the accuracy of their work, academic productivity and their behaviors while working. Moreover, strategies such as organization and visual representation of concepts are also identified in the study by Krawec, et al., (2012). This shows that even though students' knowledge of learning strategies can be utilized to support learning as indicated by Krawec, et al., (2012), such strategies must be taught students with LD prior to their use.

To facilitate math reasoning, instructors can adopt a range of approaches such as schema instruction (Kiuhara & Witzel, 2014; Maccini, Mulcahy & Wilson, 2007). Schema instruction is guided by FOPS which stands for "find the problem type, organize the information in the problem using the diagram, plan to solve the problem, and solve" (Kiuhara & Witzel, 2014, p. 237). This strategy enables procedural problem solving leading to more positive problem solving outcomes. Further, Kiuhara&Witzel (2014) discuss another strategy known as self-regulated strategy development (SRSD). It involves six phases which involve development of background knowledge, discussions on the present strategies and roles and benefits of specific strategies, modeling using think-aloud, memorization, strategy practice and independent performance. Additionally, Maccini, Mulcahy& Wilson (2007) suggested that such instruction works by assisting students with LD to comprehend the structure of specific word problems.

In their study, Maccini, Mulcahy& Wilson (2007) also discuss other strategies that can assist students with learning disabilities. They conducted a systematic review which established several strategies that can be used to ensure that students with LD learn effectively. One of the most effective strategies that they identified was the use of mnemonic strategy instruction. Fact mnemonics enables students to recall particular processes or steps to solve problems. For instance, first letter mnemonics, guided practice, modeling, pair practice and individual practice promote mnemonic strategy development (Maccini, Mulcahy& Wilson, 2007).

Maccini, Mulcahy& Wilson (2007) also identified another strategy that is effective in promoting learning among students with LD known as graduated instructional sequence. The strategy consists of three main processes namely; concrete instruction, which involves introducing students to concepts via manipulatives; semi-concrete or representational instruction, which involves gradually advancing to pictures that represent objects; and abstract instruction, which is characterized by advancement to abstract math tasks using numbers and symbols" (Maccini, Mulcahy& Wilson, 2007, p. 66). This shows that the utilization of pictures is a strategy that replicates in the different sources. It is an effective strategy because it promotes problem solution among students with LD.

Further, Maccini, Mulcahy& Wilson (2007) discusses another strategy referred to as cognitive strategy instruction. It is a strategy that assists students with learning disabilities to plan for their math activities, and their performance. The instruction involves teaching students with LD how to plan for tasks, focus on particular problems, and use different pieces of information to solve a problem, and use particular order to solve a specific problem (Maccini, Mulcahy& Wilson, 2007, p. 67). Cognitive strategy instruction allows students with LD to plan the steps they will take to solve problems, to engage in self-regulation and to complete the given tasks.

How Peer-Assisted Learning Compares with other Strategies

The topic of peer-assisted learning is mentioned by Kiuhara & Witzel (2014) in their study as noted above and it is also discussed comprehensively by other scholars. For example, a study by Tsuei (2014) was conducted to find out how a synchronous peer tutoring system helps students with LD in their learning process. In this scenario, peer tutoring consisted of technology-aided gaming which promoted social interaction among the students. The study shows that students' learning and performances improved remarkably with significant improvements noted in the learners abilities develop fluency and solve conceptual problems. This indicates that peer-assisted learning equally has the ability to enhance math learning among students with LD just like other stated strategies. Nevertheless, Tsuei (2014) stresses on the need for careful pairing and grouping of learners because some students may have similar problems and if they are put together, may not fully enjoy the benefits of peer tutoring.

In another study conducted by Calhoon and Fuchs (2003), they discussed the potential of peer-assisted learning to improve math learning among students with LD. The primary study revealed that students with LD improved significantly in their coursework from peer-assisted learning. The use of peer-assisted learning enabled students to learn better and their accuracy and problem solving skills improved remarkably. This resulted to better performance among learners who underwent peer-assisted learning (Calhoon& Fuchs, 2003). Notably, Calhoon& Fuchs (2003) insisted that peer-assisted learning should be approached with caution because students with LD regularly displayed difficulties that are associated with memory and retrieval, generalization and problem solving. Therefore, as much as this strategy is useful, it may not be successful if learners are not grouped appropriately or if they are not offered optimal guidance. Based on this observation, Calhoon and Fuchs (2003) argued that students with LD "may require teacher-led direct instruction" in order for peer-assisted learning to be effective (p. 243). Likewise, a study by Kunsch, Jitendra and Sood (2007) revealed that peer-assisted learning can be moderately beneficial to students with learning disabilities. Nonetheless, the effectiveness of peer-assisted learning lowers with the increase in problem complexity (Kunsch, Jitendra &Sood, 2007). This also shows that peer-assisted learning can only be limited to particular problems for students with LD if high efficacy is to be achieved and maintained. Conceivably, this explains why the research by the U.S. Department of Education, Institute of Education Sciences, What Works Clearinghouse (2012) found that peer-assisted learning did not have any positive influence on math learning among students with LD. This indicates that peer-assisted learning must be approached cautiously as insufficiencies in planning and implementation might lead to failure. Consequently, peer-assisted learning is more limiting that other strategies discussed above. However, this should not imply that all other strategies automatically work for all students because it is necessary to utilize strategies that appeal to learner's preferences and those that meet their exact needs.

Basing our study on the presented finding, it is clear that there is a wide variety of strategies that math teachers and instructors can use to teach students with disabilities. However, there is no specific strategy that can work effectively for all students with LD. It is therefore recommended that teachers should assess the preferences and needs before choosing any particular strategy for teaching mathematics. Furthermore, teachers should make an effort of evaluating the contexts of teaching and select teaching strategies that are appropriate for those contexts. It must be noted that for this to happen teachers have to be sufficiently trained on the best teaching strategies for students with disabilities.

Conclusion

To conclude, this review of literature reveals that there are several math teaching strategies that can assist students with disabilities to perform better in class. Therefore, math teachers should ensure that they fully comprehend the different

strategies and their benefits for students with disabilities. The major implication from this is that the math teachers should engage in continuous professional training and development to ensure that they are able to use the latest and most effective strategies, to teach math to learners with disabilities. This will ensure that all of the students enjoy a fair learning platform and none of them are disadvantaged in the course of learning. All the same, instructors should always remember to differentiate the teaching process and meet the needs of different students.

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